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(54) SAW AND IMPACT RESISTANT MEMBERS AND METHODS OF MAKING SUCH MEMBERS

(71) I, WARREN MAX SHWAYDER, a citizen of the United States of America, of 2335 East Lincoln Road, Birmingham, Michigan 48008, United States of America,

do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which is it to be performed, to be particularly described in and by the following statement:—

This invention relates to saw and impact resistant members, to padlock shackles and other bar-like members and to methods of making such members.

Padlock shackles are generally made of steel rods bent into the U-shape of a shackle and heat treated for hardness. These conventionally used shackles have only a limited resistance to saw cutting and virtually no resistance to cutting by carbide coated saws such as rod saws. In addition, they are relatively easily broken by the impact of a heavy hammer. Moreover, they can be relatively easily stretched or elongated by insertion of chisels or wedges between a shackle loop and padlock casing, so that they can be pulled out of the locked position. Thus, conventional padlocks, and particularly their shackles, provide no protection against a determined and sustained effort to break them. Thus, the invention herein relates to an improved shackle which is highly resistant to saw cutting, impact application and stretching.

According to the invention a padlock shackle comprises an elongated rod-like member bent into a shackle U-shape, said member being formed of an elongated metal core surrounded by a closely fitting, thin metal sheath, longitudinally extending shallow passageways being formed in the surface of the core; said passageways being filled with a matrix formed of closely packed particles of a hard material, and a binder material.

[Price 33p]

According to another aspect of the invention, a saw and impact resistant member comprises an elongated metal core having a closely fitted, thin wall metal sheath surrounding and in face to face contact therewith; longitudinally extending grooves, of shallow depth, formed in the surface of the core, with said grooves being filled with a matrix formed of closely packed hard particles, and a softer binder material.

A method of making a saw and impact resistant member, according to the invention, comprises the steps of forming an elongated metal core with spaced apart, longitudinally extending shallow surface grooves; closely fitting a tubular, thin walled sheath over said core; then filling said grooves from one end with a packing formed of particles of a hard material; next, heating a binder so that it flows into the grooves to fill the spaces between the particles and solidifying the binder to form a solid matrix of particles and binder; than swaging the member to elongate it, reduce its cross-sectional size and to work harden the metal. The hard particles may be of tungsten carbide. The core and sheath may be made of a work hardenable steel. Advantageously, the assembly of core, matrix and sheath is swaged to work harden the metal, elongate and form the finished diameter of the part, as well as to seal the elements together.

The finished rod-like shackle or saw and impact resistant member may be constructed so that it cannot be sawn through or broken by impact using any conventional means, including the extremely hard type carbide coated saws. While such a saw might penetrate through the thin sleeve, upon contacting the matrix, it is immediately destroyed so that it cannot penetrate deeply into the shackle. Moreover, the shackle can be constructed so as to resist repeated blows or impacts

of even a heavy sledge hammer without breaking, and it resists elongation or stretching.

In order that the invention may be clearly understood and really carried into effect, a padlock-shackle and a method of making such a shackle will now be described by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a schematic view of a padlock showing the improved shackle herein.

Fig. 2 is an enlarged cross-sectional view of the shackle taken in the direction of arrows 2-2 of Fig. 1.

Fig. 3 is an elevational view of the core, per se.

Fig. 4 shows the initial assembly of the sleeve upon the core, and

Fig. 5 shows the step of applying the binder material into the grooves which have already been filled with hard particles.

Fig. 6 is a partially cross-sectional view of the assembled rod-like member.

Fig. 7 is an elevational view, partially in cross-section, of the finished shackle.

Fig. 8 is a fragmentary, enlarged cross-sectional view of a portion of the shackle.

Fig. 1 illustrates a conventional padlock 10 having a shackle 11 which fits into and locks within the padlock casing or body 12. The construction and locking parts of the casing are omitted since these form no part of the invention herein. A locking bar 13, which is arranged within and forms part of the locking mechanism, is schematically illustrated. This bar engages notches 14 and 15 formed in the shackle to lock the shackle into the padlock casing. It should be understood that the shackle of this invention may be used with any form of padlock casing, regardless of the type of locking mechanism included therein.

The shackle is formed of a central core 16 with peripheral longitudinally extending splines and is of uniform diameter. The core lower end portion 17 is flared or it may be tapered. The core is thus provided with a number of longitudinally extending shallow grooves 18 defined between adjacent tooth-like formations of the splines.

A tubular sheath 19 is closely fitted over the core (see Fig. 4), including force fitting the lower end portion 20 of the sheath around the flared end portion 17 of the core. Additionally, where desired, the lower end portion 20 may be welded at 20a to the core lower end. As illustrated in the drawing, the tube is of greater length than the core so that its upper end portion 21 extends a distance above the upper end of the core.

The grooves 18 are filled with a matrix 22 formed of hard particles 23 (see Fig. 8) and a binder 24. The particles are of a hard metal carbide such as tungsten carbide, either cast or cemented, or other similar carbide particles which have high degreees of hardness. The binder may be of a soft metal material, such as copper solder or other suitable soldering materials. The particles are closely packed within the grooves and the spaces between them are filled with the binder to form a solid matrix.

A method of forming the improved shackle herein is as follows: First, the core 16 is formed with the longitudinally extending shallow grooves and the flared end portion 17 (see Fig. 3). Next, the thin walled tubular sheath is forced into position around the core, as illustrated in Fig. 4. Then, the hard particles are poured into the grooves, with the rod arranged upright as shown in Fig. 5, to form a packing or particles within the grooves. The space at the upper end portion 21 of the tube 19 may then be filled with pellets or beads or powder of the soldering compound, such as copper soldering pellets 25, and while the rod is held upright, it is heated to melt the solder which flows downwardly, filling the spaces between the particles. Preferably enough solder is placed into the tube, so that the upper end portion 21 of the tube is filled with soldering material above the upper end of the core. When the rod is permitted to cool and the solder to solidify, a slug 26 of solder fills the upper end portion of the sheath (see Fig. 6).

Next, the composite rod is swaged to reduce its diameter to predetermined size, while simultaneously elongating it and more importantly, work hardening the metal forming the sleeve and the core. Both of these metals are selected from the work hardenable steels, with the tube preferably being of a stainless steel material to provide greater toughness, corrosion resistance, and improved appearance.

After the swaging, the rod is of uniform cross-section, the flared portion being reduced to the common diameter of the rod.

Thereafter, the rod may be bent into the U-shaped shackle form illustrated in Fig. 7 and the notches 14 and 15 formed therein. The notch 14 may be easily cut into the shackle since it is arranged in the area of the end portion of the core where there is not matrix material. On the other hand, the notch 15, located in an area where there is matrix material, may be formed either by a suitable deformation process or electrical or heat cutting method.

Alternatively, the region into which the notch 15 is formed may be made without the groove and matrix so as to permit easy notching.

The portion of the shackle below the notch 15, that is, where the slug 26 of solder fills the tube, is concealed within the padlock casing and does not carry any unexpected loads. Thus, the slug 26 simply functions as a filler, as a place where openings may be easily drilled through for various types of locking mechanisms, and also as a heat conductor to remove heat which may be applied to the shackle.

While the materials and the sizes and shape of the shackle may vary, an example of its construction is as follows: A one-half inch diameter work hardenable 304 stainless steel rod was provided with six grooves, equally spaced apart around its surface, the grooves being approximately .12 inch wide by .08 inch deep. The grooves were filled with cemented tungsten carbide grit of approximately 12/20 inch mesh size. The sheath was made of approximately 9/16ths inch outside diameter, with a wall thickness of approximately .028 inches and formed of 304 stainless steel tubing. Conventional copper solder was used as the binder.

After the assembly, the rod was swaged down to a little less than one-half inch in diameter. The swaging also work hardened the material to roughly Rockwell C-10.

The bent shackle resisted penetration by and destroyed all available saws, including carbide coated ones of the rod-saw type, sustained in excess of 16,000 pounds tensile test and resisted breakage by repeated pounding with a conventional four pound hammer. All of the foregoing results were far in excess of any possible results achievable by conventional shackles.

While the rod-like member and method are described in connection with shackles for padlocks, it may likewise be used in other applications where similar types of penetration resistance, impact resistance and stretching resistance is desired, such as for example, protective bars, jail bars, and locking bars. Likewise, the cross-sectional shape may be varied as may the shape of the passageways which are in the surface of the core.

WHAT I CLAIM IS:—

1. A padlock shackle comprising an elongated, rod-like member bent into a shackle U-shape,

said member being formed of an elongated metal core surrounded by a closely fitting, thin metal sheath, longitudinally extending shallow passageways being formed in the surface of the core,

said passageways being filled with a matrix formed of closely packed particles of a hard material, and a binder material.

2. A padlock shackle as defined in Claim 1, said core comprising longitudinally extending tooth-shaped formations arranged around its periphery to define said passageways therebetween, and said sheath being in the form of a metal tube closely fitted upon the core for contact with the outer peripheral surfaces of said tooth formations.

3. A padlock shackle as defined in Claim 2, the sheath having an end portion extending a distance beyond one end of the core and filled with binder material, with the opposite end of the core having a short end portion which is ungrooved and in full surface to surface contact with the adjacent interior surface of the sheath.

4. A padlock shackle as defined in Claim 1, said metal being work hardenable, and said member being work hardenable.

5. A saw and impact resistant member comprising:

an elongated metal core having a closely and in face to face contact therewith;

longitudinally extending grooves, of shallow depth, formed in the surface of the core, with said grooves being filled with a matrix formed of closely packed hard particles, and a softer binder material.

6. A saw and impact resistant member as defined in Claim 5, said member being in the form of a rod, with the core having longitudinally extending splines, wherein said grooves are defined by the gaps between adjacent splines.

7. A method of making a saw and impact resitant member comprising the steps of:

forming an elongated metal core with spaced apart, longitudinally extending shallow surface grooves;

closely fitting a tubular, thin walled sheath over said core;

then filling said grooves from one end with a packing formed of particles of a hard material;

next, heating a binder so that it flows into the grooves to fill the spaces between the particles and solidifying the binder to form a solid matrix of particles and binder;

then swaging the member to elongate it, reduce its cross-sectional size and to work harden the metal.

8. A method as defined in Claim 7, wherein said sheath is made longer than the core, and the sheath and core are arranged in an upright position with the sheath extending a distance above the upper end of the core, and the binder material is placed into the upper end of the sheath above the core, the binder then being heated so that it flows downwardly into the grooves.

9. A method as defined in Claim 7, wherein said binder material is placed into the tube upper end portion in solidified

form and thereafter heated and melted so that it flows downwardly into the grooves containing the particles.

10. A method as defined in Claim 7 including bending the swaged member into the shape of a padlock shackle.

11. A saw and impact resistant member as defined in Claim 5 or Claim 6, in which said closely packed hard particles are of metal carbide.

12. A saw and impact resistant member as defined in any one of Claims 5, 6 and 11, in which said softer binder material is a copper solder material.

13. A saw and impact resistant member as defined in any one of Claims 5, 6, 11 and 12, the core being in the form of an elongated, approximately uniform cross-section rod, with the sheath being in the form of a thin wall approximately uniform diameter tube.

14. A padlock-shackle substantially as described with reference to the accompanying drawings.

15. A method of making a padlock shackle substantially as described with reference to the accompanying drawings.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG. 1

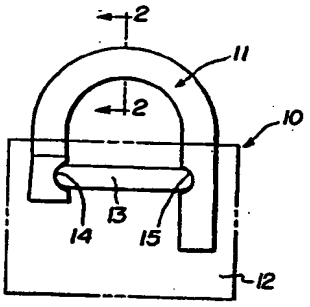
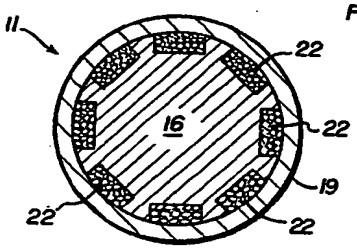


FIG. 2



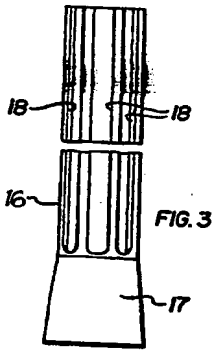


FIG. 3

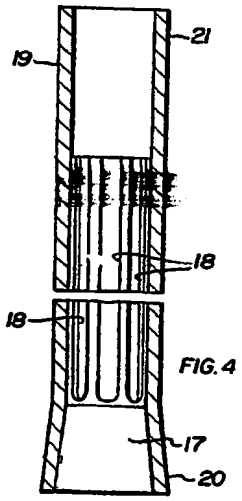


FIG. 4

1392268 COMPLETE SPECIFICATION
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Sheet 2

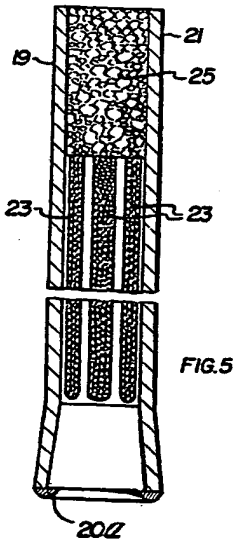

FIG. 5

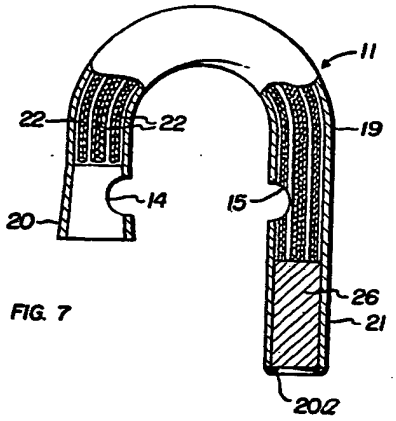

FIG. 7

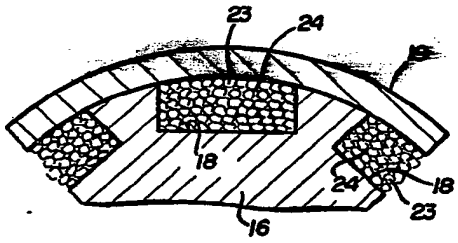

FIG. 8

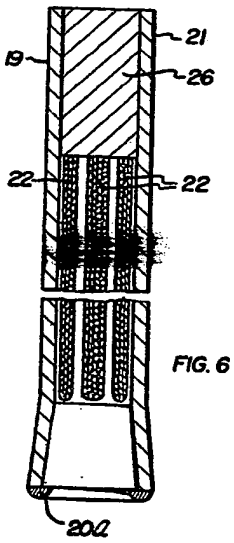

FIG. 6